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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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10/790,212

03/02/2004

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EXAMINER

KACKAR, RAM N

ART UNIT

PAPER NUMBER

1792

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PAPER

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

<b>Office Action Summary</b>	<b>Application No.</b> 10/790,212	<b>Applicant(s)</b> TANAKA ET AL.	
	<b>Examiner</b> Ram N. Kackar	<b>Art Unit</b> 1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 10 November 2008.
- 2a) ☒ This action is **FINAL**.                      2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1,2,5,6,10,11,14-20 and 23-25 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1,2,5,6,10,11,14-20 and 23-25 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)                     | 4) <input type="checkbox"/> Interview Summary (PTO-413)           |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____                                      |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)          | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| Paper No(s)/Mail Date _____  | 6) <input type="checkbox"/> Other: _____                          |

## DETAILED ACTION

### *Claim Rejections - 35 USC § 112*

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 1-2, 5-6, 10-11, 14-20 and 23-25 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

In this instance in claim 1 the limitation

“amount of edge perimeter undulation of mask sidewalls of the mask, as well as the amount of radicals measured by said plasma monitor, wherein the trimming treatment is carried out for the trimming condition calculated by said trimming condition calculating means;

wherein the edge perimeter undulation amount is calculated on the basis of an aspect ratio of a mask edge perimeter undulation portion or a Fourier frequency, of the shape of a mask edge perimeter undulation portion” is new matter.

Further in claim 10, the limitation “measured amount of edge perimeter undulation along vertical mask sidewalls, as well as the amount of radicals and the amount of ions measured by said plasma monitor, wherein the trimming treatment is carried out for the trimming condition calculated by said trimming condition calculating means: wherein the edge perimeter undulation

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amount is calculated on the basis of: an aspect ratio of a mask edge perimeter undulation portion; or, a Fourier frequency of the shape of a mask edge perimeter undulation portion” is also a new matter.

Still further in claim 18, the limitation “pre-measured amount of line edge corrugation extending along vertical mask sidewalls, as well as the amount of radicals and the amount of ions measured by said plasma monitor, wherein the line edge of the vertical mask sidewalls has corrugation consisting of alternating ridges and grooves, and wherein the amount of line edge corrugation is defined as a protrusion amount of ones of the ridges of the line edge divided by a protrusion width of the ones of the ridges of the line edge” and “wherein the edge perimeter undulation amount is calculated on the basis of: an aspect ratio of a mask edge perimeter undulation portion; or, a Fourier frequency of the shape of a mask edge perimeter undulation portion” is a new matter.

It is noted that the words “undulated” and “corrugated” used once in the specification are in themselves not new matter. The new matter is in their use in the amended limitations. According to specification they are basically synonymous with roughness or unevenness. However there appears to be an attempt to give these words some special meaning. This special meaning- if there is one- is neither understood nor appears to be supported. For example what is “edge perimeter undulation” and what is “line edge corrugation extending along vertical mask sidewalls”?

While applicants are allowed to give special meaning to words, the special meaning should be disclosed clearly.

In this case it is not clear if applicant wants to give -what if any- special meaning to terms like roughness, unevenness, undulation or corrugation.

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 1-2, 5-6, 10-11, 14-20 and 23-25 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

In this instance the limitation “pre-measured amount of line edge corrugation extending along vertical mask sidewalls, as well as the amount of radicals and the amount of ions measured by said plasma monitor, wherein the line edge of the vertical mask sidewalls has corrugation consisting of alternating ridges and grooves, and wherein the amount of line edge corrugation is defined as a protrusion amount of ones of the ridges of the line edge divided by a protrusion width of the ones of the ridges of the line edge” and others as above are not only a new matter but are indefinite as being unclear.

### ***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**6. Claims 1-2, 5-6, 10-11, 14-20 and 23-25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kagoshima et al (US Pub 2003/0003607) in view of an Article “ Modeling the impact of photoresist trim etch process on photoresist surface roughness” by Shahid Rauf et al.**

Kagoshima et al disclose an etching apparatus for etching of mask features (Fig 1 and Abstract) with plasma and a plasma monitor (3) which could be an optical emission spectroscopy (OES) or quadrupole mass spectrometer (QMS) to monitor the species in the plasma (species of plasma contain ions and radicals which react with the substrate to do etching – Paragraph 27 and 44). Kagoshima teaches optimum recipe calculation model which depends upon the monitored result from the plasma monitor (24) and the measurement of CD (22).

Kagoshima et al fail to disclose the roughness parameter of the resist and its inclusion in the recipe calculation model.

Shahid Rauf et al have extensively studied dependence of etch rate upon roughness (undulation or corrugation) when all other factors remain same. They teach that the etch rate is high at the beginning if the initial roughness is high, and reduces when the roughness is reduced. So that it is essential to know the initial roughness in order to estimate etch time needed to etch to target CD. Shahid Rauf et al teach that the roughness factor (RF) is measured as in Fig 1 by R profile of the roughness part and the spatial frequency computed using Fourier transform (Page 656 Col 2). Since the roughness parameter is correlated to etch rate just like RF Power, gas flow, gas pressure and plasma density etc are correlated to it, its inclusion in the recipe calculation model would not only be obvious but essential. Further since etch rate is correlated to roughness

and reduction of roughness is faster in the beginning of an etch (Fig 4) the time to etch to a target CD is affected by the initial roughness.

Therefore it would have been obvious for one of ordinary skill in the art at the time of invention to provide to the optimum recipe calculation model of Kagoshima et al, not only the monitored result of the plasma monitor and the measured CD, but the initial roughness (RF) of the mask in order to deal with the effect of roughness on recipe time.

Regarding 11, this is an intended use claim.

Regarding claim 18 trimming condition calculating means is provided by the model, which includes the initial roughness parameter, which is calculated in the claimed way by Shahid Rauf et al.

Regarding claim 19, Shahid Rauf et al teach that due to roughness the protrusions (positive roughness) get etched faster compared to indentations (negative roughness) so that in the beginning, etch process will mainly etch protrusions and roughness will reduce. Therefore total trim time will compose of roughness etch time and regular trim time.

### ***Response to Arguments***

Applicant's arguments filed 11/10/2008 have been fully considered but they are not persuasive.

This response is in addition to previous remarks which are part of the record.

Applicant's arguments against the rejection on the basis of 35 U.S.C. 112 are not persuasive. The arguments contain statements which are not fully supported by specification.

In response to applicant's argument, Examiner has tried to explain the issue of new matter further (See above).

Following is noted in response to applicant's arguments regarding 35 U.S.C. 103 rejections:

- 1 Applicants explanation of Fig 5A is not supported by the specification.
- 2 There is nothing in the specification to suggest that new Fig P represents the roughness the claimed invention is concerned with.
- 3 Applicant attempt to draw conclusions on the basis of applicants own interpretation of Fig 5A and Rauf's drawing without adequate support from specification or from common knowledge in the art is misleading.

Applicant continues to mischaracterize the relevant teachings of the article with total disregard to previous response of record.

### ***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37



CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ram N. Kackar whose telephone number is 571 272 1436. The examiner can normally be reached on M-F 8:00 A.M to 5:P.M.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on 571 272 1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Ram N Kackar/  
Primary Examiner, Art Unit 1792